SAFETY ALERT 069

NTSB National Transportation Safety Board

September 2017

AVIATION
HIGHWAY
MARINE
RAILROAD
PIPELINE

Pilots: Prevent Carbon Monoxide Poisoning

The risk of carbon monoxide poisoning is overlooked and underestimated!

The problem

- **Carbon monoxide (CO)** is a colorless, odorless, tasteless gas by-product of internal combustion engines and is found in exhaust gases. Sufficiently high levels of CO in your bloodstream will lead to oxygen starvation and the onset of symptoms (such as headaches, drowsiness, nausea, or shortness of breath).
- Many internal combustion engine airplanes are heated by air that has been warmed by circulating air around the exhaust system using a heater shroud. **A defect or leak in the exhaust pipes or muffler can introduce CO into the cockpit.**
- Pilots often overlook or dismiss the onset of symptoms and don't connect them with the possibility of exposure to CO. Continued exposure increases risks to pilots, including impaired judgment and decreased ability to control the airplane and, eventually, incapacitation and death.

Related accidents

The National Transportation Safety Board (NTSB) has investigated several accidents (some fatal) in which pilots were incapacitated following CO exposure, such as the following:

- **A Mooney M20C airplane crashed in a field following the pilot's incapacitation;** the pilot was seriously injured. Shortly after departure, the pilot lost consciousness and air traffic control was unable to contact the pilot. The airplane continued to fly for about 1.5 hours until the fuel in the selected tank was exhausted. The pilot's CO level was at least 28% (and likely higher) at the time of the accident. CO levels between 10% and 20% can result in confusion, impaired judgment, and difficulty concentrating. Postaccident examination of the airplane found a fracture in the exhaust/heater muffler (see left photograph in figure 1) and exhaust deposits inside the muffler shroud (right photograph in figure 1). This allowed the exhaust gas to enter the cabin, exposing the pilot to CO. (CEN17LA101)

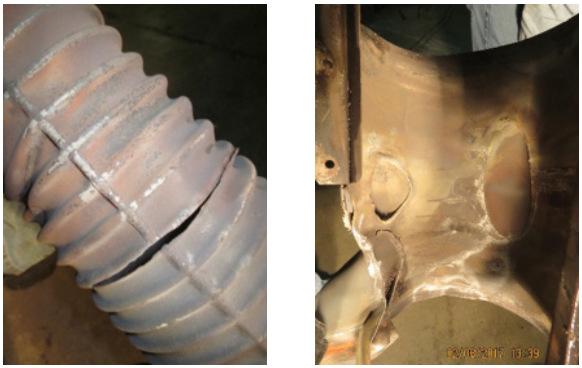

Figure 1. Photographs of a cracked muffler and exhaust deposits in the muffler shroud.

- **Witnesses observed an experimental amateur-built, Hefty Polar Cub airplane flying erratically at a low altitude before impacting terrain.** A postcrash fire ensued, and the pilot was fatally injured. Toxicology testing revealed that the pilot's CO level was 48%; no soot was found in his airways, indicating the CO was not a result of the fire; thus, the NTSB determined that the pilot's severe CO impairment likely caused the pilot's loss of control. Examination of the airplane's exhaust system revealed that the exhaust/heater muffler was fractured, allowing CO to enter the cockpit (see figure 2). (ANC16FA065)

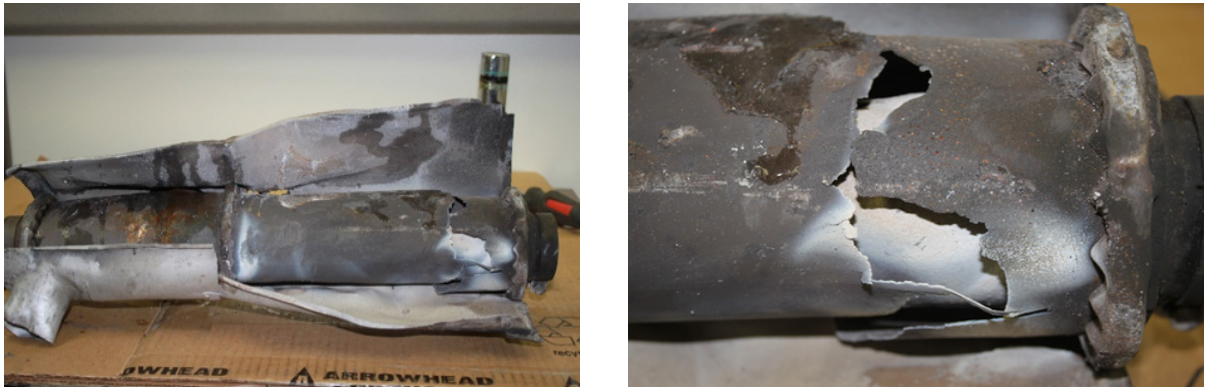

Figure 2. Fractured exhaust muffler from a Hefty Polar Cub airplane (left) and a close-up photograph of the fracture in the exhaust muffler (right).

- **About 3 hours into a 3.5-hour postmaintenance flight, a Cessna 207 airplane impacted trees and a river.** The pilot was fatally injured. Toxicology tests identified a CO level of 21% in the pilot's blood, which likely adversely affected his performance. The airplane's original cabin heat system had been modified with a "winter heat kit" that, according to maintenance records, had not been installed in accordance with Federal Aviation Administration (FAA) field approval procedures. The full heat system was not recovered, and it was not possible to determine the exact source of the CO. (ANC15FA032)
- **A Bellanca 14-19-3A descended from cruise flight at a rate of 2,900 ft per minute and collided with power lines and trees.** The pilot was fatally injured. The wreckage examination revealed cracks and holes in the muffler wall and exhaust gas penetration into the interior of the shroud. Toxicology tests identified a CO level of 37% in the pilot's blood. Most of the CO detected in the pilot's blood was likely from inhalation during the flight; the CO levels would have impaired his ability to safely fly the airplane. (CEN14FA024)

What can YOU do?

- **Install a CO detector and replace the device and its batteries in accordance with manufacturers' guidelines. Detectors mounted on the instrument panel with aural alerts and a flash notification are more likely to draw your attention and alert you to a potential hazard.**
- **During an annual or 100-hour inspection, make sure your mechanic thoroughly inspects exhaust systems, air ducting, firewalls, and door/window seals. Always perform an advanced preflight inspection after maintenance.**
- **Be informed and familiarize yourself with your airplane's exhaust system. Review and comply with any airworthiness directive, advisory circulars, and service bulletins regarding the exhaust system. Speak with your mechanic about regular inspections, the condition of the muffler, and the replacement schedule of parts.**
- **During preflight inspections, check the security and condition of the exhaust system. Look for cracking at the ends of the muffler; if you see signs of soot or exhaust flames, don't fly the airplane until it is examined by a mechanic. If you cannot see the muffler, inspect the shroud for any evidence of soot that might indicate cracking in the muffler.**
- **During flight, if you believe you have been exposed to CO, don't hesitate to act.**
  - Early symptoms are vague and may involve a headache or nausea. Other symptoms include impaired judgment, disorientation, or dizziness. Most people don't recognize the problem until it's too late.
  - Prolonged exposure can have increasingly dangerous effects on your ability to control the airplane. Open windows, turn off the heat, land as soon as practical, and seek emergency medical attention.

Interested in more information?

The following FAA resources are accessible via www.faa.gov:

- "Carbon Monoxide (CO) Contamination in Aircraft – Detection and Prevention" (Advisory Circular [AC] 20-32B) contains information on the potential dangers of CO exposure from faulty engine exhaust systems or cabin heaters, means of detecting CO, and procedures to follow when exposure is suspected.
- "Acceptable Methods, Techniques, and Practices – Aircraft Inspection and Repair" (AC 43-13-1B) contains inspection methods and repair techniques in chapter 8 to prevent exhaust system failures that could lead to CO exposure.
- "Engine Exhaust and Carbon Monoxide Detectors" (Special Airworthiness Information Bulletin CE-10-19R1) informs owners and operators of the importance of installing CO detectors.
- FAA brochure *Carbon Monoxide: A Deadly Menace* contains medical information concerning the symptoms of CO exposure and methods of avoiding exposure.

A companion video to this safety alert can be accessed from the Aviation Safety Alerts link.

The reports for the accidents referenced in this safety alert are accessible by NTSB accident number from the Aviation Accident Database link, and each accident's public docket is accessible from the Accident Dockets link for the Docket Management System.

The NTSB's Aviation Information Resources web page, www.ntsb.gov/air, provides convenient access to NTSB aviation safety products. This Safety Alert and others can be accessed from the Aviation Safety Alerts link at www.ntsb.gov.

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The NTSB is an independent federal agency charged by Congress with investigating every civil aviation accident in the United States and significant accidents in other modes of transportation—highway, marine, railroad, and pipeline. The NTSB determines the probable cause of the accidents and issues safety recommendations aimed at preventing future accidents. For more information, visit **www.ntsb.gov.**